

## Claims

[c1] In a tube fitting of the type including a fitting body having a cylindrical bore for receiving a tube end and including a tapered mouth at one end of said bore; a drive member having a threaded engagement with said body and having a ferrule drive surface; a first ferrule having a tapered first end that extends into said tapered mouth of the fitting body and having a second end with a tapered recess that axially extends toward said first end; and a second ferrule having a substantially continuous cylindrical interior wall that closely surrounds the tube end, a tapered nose portion that extends into said tapered recess of said first ferrule, and a driven surface on a back end thereof that engages said ferrule drive surface; the improvement wherein said second ferrule is case hardened about its entire surface, said second ferrule has a rear portion of said cylindrical interior wall that is radially spaced from the tube end upon pull-up of the fitting, a forward edge of said tapered nose portion that penetrates an outer surface of the tube end, and a collet portion of said substantially continuous cylindrical interior wall that is axially behind said forward edge and that upon pull-up of the fitting is deformed radially against

said outer surface of the tube end to collet the tube end.

- [c2] The fitting of claim 1 wherein said second ferrule is deformed during pull-up of the fitting by a toggle-like hinging action.
- [c3] The fitting of claim 2 wherein said toggle-like hinging action results from said rear portion moving radially outward from said outer surface of the tube end about a region of said second ferrule that joins said rear portion to said collet portion.
- [c4] The fitting of claim 3 wherein said toggle-like hinging action causes said collet portion to be radially compressed against said outer surface of the tube end with a high gripping pressure upon pull-up of the fitting.
- [c5] The fitting of claim 3 wherein said drive member ferrule drive surface initially contacts said second ferrule driven surface at a location radially outward to at least a central portion of said second ferrule driven surface.
- [c6] The fitting of claim 1 wherein said driven surface is convex.
- [c7] The fitting of claim 1 wherein said second ferrule interior cylindrical wall comprises a circumferential recess between said forward edge and said back end.

- [c8] The fitting of claim 1 wherein said second ferrule comprises metal.
- [c9] The fitting of claim 8 wherein said metal comprises stainless steel.
- [c10] In a tube fitting of the type including a fitting body having a cylindrical bore for receiving a tube end and including a tapered mouth at one end of said bore; a drive member having a threaded engagement with said body and having a ferrule drive surface; a first ferrule having a tapered first end that extends into said tapered mouth of the fitting body and having a second end with a tapered recess that axially extends toward said first end; and a second ferrule having a substantially continuous cylindrical interior wall that closely surrounds the tube end, a tapered nose portion that extends into said tapered recess of said first ferrule, and a driven surface on a back end thereof that engages said ferrule drive surface; the improvement wherein said second ferrule has a rear portion of said cylindrical interior wall that is radially spaced from the tube end upon pull-up of the fitting, a forward edge of said tapered nose portion that penetrates an outer surface of the tube end, and a collet portion of said substantially continuous cylindrical interior wall that is axially behind said forward edge and that upon pull-

up of the fitting is deformed by a toggle-like hinging action that results from said rear portion moving radially outward from said outer surface of the tube end about a region of said second ferrule that joins said rear portion to said collet portion.

- [c11] The tube fitting of claim 10 wherein said collet portion is radially compressed against said outer surface of the tube end to collet the tube end with a high radial gripping pressure.
- [c12] The tube fitting of claim 10 wherein said second ferrule is case hardened about its entire surface.
- [c13] The fitting of claim 10 wherein said drive member ferrule drive surface initially contacts said second ferrule driven surface at a location radially outward to at least a central portion of said second ferrule driven surface.
- [c14] The fitting of claim 10 wherein said second ferrule comprises metal.
- [c15] The fitting of claim 10 wherein said metal comprises stainless steel.
- [c16] In a tube fitting of the type including a fitting body having a cylindrical bore for receiving a tube end and including a tapered mouth at one end of said bore; a drive

member having a threaded engagement with said body and having a ferrule drive surface; a first ferrule having a tapered first end that extends into said tapered mouth of the fitting body and having a second end with a tapered recess that axially extends toward said first end; and a second ferrule having a substantially continuous cylindrical interior wall that closely surrounds the tube end, a tapered nose portion that extends into said tapered recess of said first ferrule, and a driven surface on a back end thereof that engages said ferrule drive surface; the improvement wherein said second ferrule driven surface has a generally convex contour, a forward edge of said tapered nose portion that penetrates an outer surface of the tube end, and a portion of said substantially continuous cylindrical interior wall that is radially compressed by a toggle-like hinging action to collet the tube end near said forward edge.

[c17] The tube fitting of claim 16 wherein said second ferrule is case hardened over its entire surface.

[c18] The tube fitting of claim 16 wherein said second ferrule has a rear portion of said cylindrical interior wall that is radially spaced from the tube end upon pull-up of the fitting.

[c19] The fitting of claim 16 wherein said second ferrule com-

prises metal.

[c20] The fitting of claim 16 wherein said metal comprises stainless steel.

[c21] In a tube fitting of the type including a fitting body having a cylindrical bore for receiving a tube end and including a tapered mouth at one end of said bore; a drive member having a threaded engagement with said body and having a ferrule drive surface; a first ferrule having a tapered first end that extends into said tapered mouth of the fitting body and having a second end with a tapered recess that axially extends toward said first end; and a second ferrule having a substantially continuous cylindrical interior wall that closely surrounds the tube end, a tapered nose portion that extends into said tapered recess of said first ferrule, and a driven surface on a back end thereof that engages said ferrule drive surface; the improvement wherein said second ferrule driven surface has a generally convex contour, a forward edge of said tapered nose portion that penetrates an outer surface of the tube end, a portion of said substantially continuous cylindrical interior wall that is radially compressed to collet the tube end near said forward edge, and a rear portion of said cylindrical interior wall that is radially spaced from the tube end upon pull-up of the fitting.

- [c22] The tube fitting of claim 21 wherein said second ferrule is case hardened over its entire surface.
- [c23] The fitting of claim 21 wherein said second ferrule is deformed during pull-up of the fitting by a toggle-like hinging action.
- [c24] The fitting of claim 23 wherein said toggle-like hinging action results from said rear portion moving radially outward from said outer surface of the tube end about a region of said second ferrule that joins said rear portion to said collet portion.
- [c25] The tube fitting of claim 24 wherein said second ferrule is case hardened over its entire surface.
- [c26] The fitting of claim 21 wherein said drive member ferrule drive surface initially contacts said second ferrule driven surface at a location radially outward to at least a central portion of said second ferrule driven surface.
- [c27] The fitting of claim 21 wherein said second ferrule interior cylindrical wall comprises a circumferential recess between said forward edge and said back end.
- [c28] The fitting of claim 21 wherein said second ferrule comprises metal.
- [c29] The fitting of claim 21 wherein said metal comprises

stainless steel.

[c30] A tube fitting comprising: a fitting body having a cylindrical bore for receiving a tube end and including a tapered mouth at one end of said bore; a drive member having a threaded engagement with said body and having a ferrule drive surface; a first ferrule having a tapered first end that extends into said tapered mouth of the fitting body and having a second end with a tapered recess that axially extends toward said first end; and a second ferrule having a generally cylindrical interior wall, a tapered first end that extends into said tapered recess of said first ferrule, a tapered outer wall portion, and a driven surface on a second end thereof that engages said drive member ferrule drive surface; said second ferrule interior wall having a first circumferential recess located between said first and second ends of said second ferrule; said tapered wall portion having a second circumferential recess near said first end; said recesses reducing force concentrations on said drive member drive surface when the fitting is pulled up.